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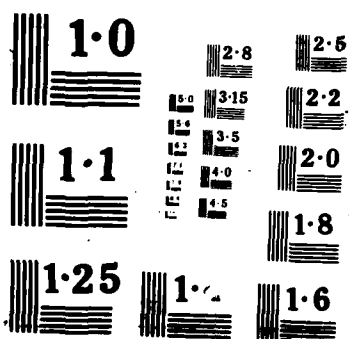
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by

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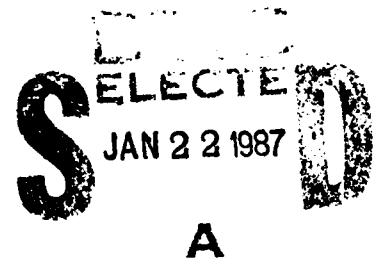
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TOWARDS JUSTIFYING ENLISTMENT STANDARDS: LINKING INPUT CHARACTERISTICS TO JOB PERFORMANCE

→The Job Performance Measurement (JPM) Project has broken new ground by embarking on the large-scale development and administration of hands-on job performance tests. In the next stage, this pioneering effort can go even further in helping to rationalize the selection and classification process by evaluating the cost-effectiveness of enlistment standards. The Department of Defense has never had a sound empirical basis, in terms of job performance, for setting minimum standards or for establishing the distribution of aptitudes and educational levels required of enlisted recruits. If the JPM Project is carried through to a successful conclusion, the joint efforts of the services can provide such an empirical basis.

“The process of evaluating the cost-effectiveness of enlistment standards, which includes determining the mix of aptitude levels required to sustain the career enlisted force, may be characterized as follows:

- Measure job performance,
 - Establish the relationship between job performance and accession attributes (e.g., aptitude, education, job experience, etc.),
 - Determine constraints on the linkage model,
 - Estimate the costs associated with operating the force.
 - Evaluate alternative enlistment standards for their cost-effectiveness.

Each of these steps are examined and discussed in light of their impact on setting justifiable enlistment standards.¹

¹For this paper, “standard” is used in the context of determining an enlistment standard or cutoff score on an aptitude composite used for entrance into a particular military occupational specialty. This is in contrast to the other papers of this symposium that use the term to refer to determining score intervals on the criterion performance measure for categorization of job competencies.



Measuring Job Performance

For the purpose of linking job performance to enlistment standards, the performance measure must be an accurate reflection of an individual's ability to perform his or her job responsibilities. For this to be true, the performance test must sample job tasks from the entire spectrum of job requirements, not just from those tasks that are more difficult, complex, or most frequently performed.

If a test is designed so that it is more difficult than the true job, then the enlistment standard resulting from this harder test would be higher than the enlistment standard generated by a test of true job tasks. That is, given a moderate correlation between performance and aptitude, more lower-ability personnel will be eligible based on the representative test as opposed to the harder test. Thus, while lower-ability individuals can satisfactorily perform the full range of job responsibilities, they can not necessarily perform the most difficult job tasks. Therefore, without explicit justification for the sampling of test content from the *full* domain of job requirements, the linkage of test performance and enlistment standards could result in standards that are too high or low, depending on the direction of bias in task sampling.

If the performance test is properly constructed so that the full range of job requirements are represented and the test score reflects how much of the job an individual can perform, then the score resulting from this test is a competency score. That is, a score of 75 percent-correct on the performance measure implies that the individual can perform 75 percent of the job requirements. Whether the continuous percent-correct score should be categorized into mastery levels, either for convenience or for other applications, is not an issue that directly relates to the setting of enlistment standards.

It is recommended that the expenditure of experts' knowledge be invested in the definition of job requirements and task sampling so that the linkage of test scores to the domain of job requirement will result in a continuous competency score scale. In this manner, the distribution of test

scores will mirror the distribution of proficiency within the specialty. The use of experts' time and resources on the difficult task of determining cutoff scores that define broad qualitative categories of competency (e.g., mastery versus nonmastery) on an unrepresentative task score scale is not productive and misdirected for the purpose of establishing enlistment standards.

Finally, it is also important to note the policy ramifications for the defining of job requirements and sampling of job tasks for the test. These decisions can not be made by testing psychologists or researchers, but rather the decision process must readily involve service job experts, subject matter experts, and policy representatives.

Relating Job Performance to Accession Attributes

To directly link enlistment standards to job performance, it is necessary to determine the relationship between the attributes of accessions (e.g., aptitude, educational level, job experience) and the hands-on test scores. Depending upon the input characteristics available for the accessions group, the prediction of job performance can be quite complex. For the analysis of the upcoming Marine Corps testing of the Infantry Occupational Field, four input characteristics have been identified: aptitude, probability of retention, time in service or experience, and educational level. Each of these characteristics have been shown to strongly impact the prediction of hands-on test performance [1]. Note that the Armed Forces Qualification Test (AFQT) is not included since it is highly correlated with the General Technical aptitude composite used for the Infantry specialties.

Description of the upcoming Marine Corps testing of the Infantry Occupational Field will help in developing the regression of hands-on test performance (called predicted performance throughout this paper) on the accession attributes. The Marine Corps will test approximately 200 infantrymen at each of four yearly intervals during the first term of enlistment. For all of these individuals, aptitude composite scores will be available. The probability of retention at each of the four time intervals and for the completion of training will be known from other data sources. Both high school and

non-high school graduates will be included in the sample. The relationships between these variables is given by the following regression:

$$P_p = \left[B_0 + A + R_i \sum_{i=1}^5 (T_i + AT_i) + e \right] : E. \quad (1)$$

where

- P_p = predicted hands-on performance
- B_0 = grand mean or constant for difficulty of MOS
- A = aptitude composite score
- R_i = probability of retention at time interval i
- T_i = time in service interval (dummy variable)
- AT_i = aptitude-time interval interaction
- e = error
- E = educational level (HSG, NHSG).

The above regression equation assumes that different coefficients will be necessary to express the relationship between hands-on job performance and the input characteristics of aptitude, retention, and time in service for high school versus non-high school graduates. That is, while non-graduates on average have lower aptitude, their performance generally improves faster with time in service than graduates with higher aptitude. Accordingly, the regressions weights for these variables will differ depending upon educational status. Likewise, there are different retention rates throughout the first term for these two groups. The effects of time in service and the interaction of time and aptitude are weighted by the probability of retention through these five time periods (completion of training plus yearly retention rates for four years). The time intervals are represented by dummy variables, so in essence this is five separate regressions because an individual can only be in one time interval. The overall regression assumes that retention and aptitude are not correlated; however, if they are, this interaction term can also be included in the equation.

The regression in equation 1 is one possible formulation of the relationship of job performance and accession attributes. Given other input characteristics or even composite definitions of job performance, the structure of the regression will most likely change significantly. An important

issue for the joint service project to address is the stability of the regression weights across the variety of surrogate measures that are being developed (e.g., job knowledge tests, walk-through interviews, task simulations, and ratings). To the extent that the weights are not similar, the case for substitutability for the hands-on tests is weakened.

Determining Model Constraints

In evaluating the cost-effectiveness of enlistment standards, either cost or performance must be fixed, and then the other factor allowed to vary. The argument advanced here is that performance should be held constant and then cost minimized for attaining that level of performance. In practice, of course, cost is fixed to a large degree by budgetary constraints. With adequate justification, however, budgets can be changed. A thrust of the JPM Project is to provide a sound empirical basis for obtaining the funds required to procure and maintain an effective enlisted force.

The primary constraint on the model proposed here is that a cohort of accessions should achieve a prescribed level of performance. This implies that any set of enlistment standards must produce a cohort of accessions whose predicted performance is satisfactory or better. Without this constraint, or a similar one, the aggregate level of performance could fall below the required level and the enlistment standards could have dire consequences.

Determining this prescribed level of performance is a difficult task but one that is implicitly done in each of the services. All services have developed manning documents that detail the force structure. The structure is defined in terms of the number of people authorized at each skill level or rank. Through years of experience, policy makers have decided in general terms what level of performance to expect from people at various ranks. The proposed Marine Corps procedure attempts to formalize the decision-making process by having job experts rate the level of performance expected from people at each rank in an occupational specialty.

The ratings of expected performance could be in terms of the percentage of job requirements that individuals at each rank should be able to perform. Thus the ratings of expected performance could be directly compared to the level of predicted performance (from the regression analysis). The standards of expected performance would be judged at two levels: desirable (e.g., applied during good conditions when an adequate supply of qualified people is available for promotion) and minimum (e.g., applied when people must be promoted before they are fully qualified). These judgments, if they can be made reliably, together with the authorized grade structure, would determine the distribution of performance required in an occupational specialty. The predicted performance of a cohort of accessions should satisfy the expected performance required in that specialty.

Estimating Costs

Estimating costs associated with operating a force is an onerous process, particularly as differential cost estimates are required for various accession strata to obtain more precise evaluations of the cost-effectiveness of enlistment alternatives. It is often the case that data are not available nor in proper form for the determination of costs associated with particular aspects of operating a force. This section does not focus on how such cost estimates can be obtained, but rather details cost factors that might potentially be considered as important for inclusion in the cost-performance model.

- *Recruiting.* It is generally the premise that higher-ability personnel are more costly to recruit than their lower-ability counterparts. This is reflected in allocation of the recruiters' time, effort, and travel expenses in seeking to enlist high school graduates. Also, additional expenses are incurred by the services as enlistment bonuses or educational programs are used as incentives to lure the more qualified personnel.
- *Training.* While it may be argued that all personnel receive the same basic and even advanced training (in this case, training would be a

fixed cost), it may be true that some personnel groups are trained to differing levels of proficiency. This may be reflected in the length of training necessary to achieve a mastery level of the subject matter or, if training time is fixed, differential training pass rates. The costs of training are magnified even more for certain personnel groups if individuals who fail are recycled back through the training program or assigned to another specialty.

- *Force Maintenance.* In many instances, force maintenance costs can be considered fixed as they apply to all personnel regardless of their ability or educational level. However, to the extent that such factors as pay, bonuses, leave, accommodations, or other such amenities are differentially allocated to personnel, these costs should be explicitly associated with the particular personnel group.
- *Attrition.* Given that individuals who leave the service must be replaced, there are costs associated with recruiting, training, and maintaining a replacement to a performance level on par with the individual who left. To the degree that some groups of individuals have a greater propensity to drop out than others, variable costs associated with these groups will be experienced by the services.
- *Discipline.* Some personnel tend to be reprimanded for misconduct more frequently than others. To the extent that the service must maintain facilities and manpower to address this problem, experience personnel inadequacies or losses in certain areas, realize substandard job performance, or repair any damage resulting from the misconduct, these types of costs accumulate and should possibly enter into the cost formulations for evaluation of alternative standards.
- *Reenlistment.* Not all persons qualify for reenlistment. Indirect costs are associated with those personnel who do not qualify, because the service has a great deal of training and on-the-job experience invested in that individual. If certain groups of personnel are more likely to qualify than others, then this could be considered as a variable in the estimation of total costs.

The determination of costs associated with these factors is an ambitious but required endeavor. Certainly, there are other cost factors that can be included, but given that the cost estimates are probably correlated across personnel groups, the inclusion of additional factors will only magnify the differential costs. Therefore, the careful estimation of some subset of the above costs, as opposed to the incomplete estimation of all factors, will at least provide a conservative or lower bound estimate. The first three factors are probably the most pertinent to the issue of setting enlistment standards (attrition and discipline can possibly be subsumed under force maintenance).

Evaluating Alternative Enlistment Standards

The final step of the linkage process is to evaluate alternative enlistment standards in terms of their cost-effectiveness. That is, which cutoff score on the aptitude composite will achieve the prescribed level of expected performance for the least cost? Conceptually, this is the easiest stage because the costs are simply computed for differing standards with the resulting quality mix of accessions being determined by the previous relationship established between job performance and accession attributes (step 2). Operationally, this step is more difficult. However, the Rand Corporation has developed a prototype model that synthesizes the job performance criterion data, the cost estimates, and the determined job performance - accession attribute relationship [2,3].

The Rand model actually defines two composite performance criterion measures: one that reflects an individual's ability to remain in the service (retained man-months) and another that extends this retention measure by including an assessment of on-the-job performance (qualified man-months). The first Rand study [2] constrained the number of retained man-months while optimizing qualified man-months at minimum cost. The results showed that force end-strength figures were reasonably well maintained. However, it should be noted that retained man-month is an aggregate number that is *not* dependent on the distribution of predicted performance. Thus, it is possible that cost-effective enlistment standards

constrained by retained man-months would possibly not result in a distribution of predicted performance needed for sustaining the career enlisted force. Conversely, the number of qualified man-months could have been constrained instead and total costs minimized. In this case, force size can vary, which may not be appropriate either.

In addition, the qualified man-month performance measure, as applied in the Rand papers [2,3], is essentially a dichotomous variable based on an individual's ability to pass the Army Skills Qualification Test (SQT). The model treats individuals who just barely pass the SQT as comparable to those who perform extremely well on the test. In this manner, individual differences are potentially ignored. Accordingly, the model will favor recruiting individuals who score just above the cutoff score on the SQT because they are generally less expensive to recruit. Thus, it is recommended that a continuous performance measure (like the predicted performance variable discussed earlier) be incorporated in the Rand model. This should be a rather simple substitution in that a mean performance score (e.g., AFQT category I personnel average 94 percent correct on the SQT) could replace the predicted SQT pass rates (e.g., 96 percent of AFQT category I personnel pass the SQT).

Summary Remarks

The issue of linking job performance measures to enlistment standards has not received the attention that it deserves by the Job Performance Measurement Working Group. The primary concern of this working group and the services was to develop the necessary technology and gain experience in constructing hands-on job performance tests. Now that each of the services have gained this experience and have collected performance data, the linkage topic will certainly come to the forefront. However, except for the Rand studies, there is little experience to build upon in the area of relating hands-on performance criterion to tests of cognitive functioning. Thus, the challenge faced by the services is to develop a better understanding of what is involved in the linkage process. This paper has sought to address this concern by briefly outlining the steps involved in the process. Certainly,

these steps do not encompass the entire linkage process, but at least they may provide a starting point for discussion among the services.

In addition to gaining a firmer technical understanding of relating performance measures to ASVAB scores, it is imperative that each service recognize the importance of involving their policy makers from the very beginning. The determination of enlistment standards is an extremely policy-oriented decision. From the defining of job requirements and the selection of test content to the determination of expected performance required by the service, important decision must be made by the service experts and policy representatives. To the extent that policy makers are involved in the entire linkage process, they will make better and more informed decisions.

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